

THE CLAIMS

What is claimed is:

- 1 1. A wellbore system for producing seismic energy in an earth formation,
2 comprising:
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 - 4 (a) a cavity containing a fluid, said cavity disposed in a wellbore; and
 - 5 (b) a drive source in fluid communication with said cavity for generating
6 pressure waves in said cavity, said cavity producing seismic waves in the earth
7 formation in response to said pressure waves, said cavity and said drive source
8 forming a closed loop through which said fluid circulates.
- 1 2. The wellbore system of claim 1 wherein said drive source generates
2 pressure waves at a selected resonance frequency of said cavity.
- 1 3. The wellbore system of claim 1 wherein said drive source includes at least
2 one of (i) a rotary valve, (ii) an electro-solenoid oscillator, and (iii) a pump.
- 1 4. The wellbore system of claim 1 wherein said drive source for generating
2 pressure waves is activated in a range of predetermined frequencies to create a
3 swept frequency signal input.
- 1 5. The wellbore system of claim 4 wherein said swept frequency signal input
2 is at least one of: i) an upswing, ii) a downswing, iii) a nonlinear sweep, a
3 psuedo-random sweep and iii) a random sweep.
- 1 6. The wellbore system of claim 1 further comprising seismic sensors to
2 record said produced seismic waves.

1 7. The wellbore system of claim 1 wherein said fluid is at least one of: (i) a
2 liquid, and (ii) a gas.

1 8. The wellbore system of claim 1 wherein said cavity is shaped to provide a
2 broad frequency signal for said seismic waves in said earth formation.

1 9. The wellbore system of claim 1 wherein said fluid comprises a smart fluid.

1 10. The wellbore system of claim 9 further comprising at least one coil
2 provided adjacent said cavity, said coil providing an excitation field for said smart
3 fluid in said cavity when energized.

1 11. The wellbore system of claim 10 wherein an effective length of said smart
2 fluid in said cavity can be controlled by selectively energizing said coil.

1 12. The wellbore system of claim 11 wherein said at least one coil includes a
2 plurality of segments, each of which can be separately energized.

1 13. The wellbore system of claim 10 wherein said at least one coil is
2 configured to provide an adjustable magnitude of intensity for said excitation
3 field.

1 14. The wellbore system of claim 10 further comprising a control unit operably
2 coupled with one of said drive source and said coil.

1 15. The wellbore system of claim 14 further comprising at least one sensor
2 connected to said control unit, said at least one sensor configured to measure a
3 selected parameter of interest.

1 16. The wellbore system of claim 15 wherein said selected parameter of
2 interest is selected from a group consisting of (i) pressure, (ii) temperature, (iii)

3 seismic energy, (iv) flow rate, and (v) frequency of pressure signals generated by
4 said drive source.

1 17. The wellbore system of claim 15 wherein said control unit adjusts said
2 drive source in response to a measurement provided by said at least one sensor.

1 18. The wellbore system of claim 1 further comprising a control unit operable
2 coupled with one of said drive source.

1 19. The wellbore system of claim 18 further comprising at least one sensor
2 connected to said control unit, said at least one sensor configured to measure a
3 selected parameter of interest.

1 20. The wellbore system of claim 19 wherein said selected parameter of
2 interest is selected for a group consisting of (i) pressure, (ii) temperature, (iii)
3 seismic energy, (iv) flow rate, and (v) frequency of pressure signals produced by
4 said drive source.

1 21. The wellbore system of claim 19 wherein said control unit adjusts said
2 drive source in response to a measurement provided by said at least one sensor.

1 22. A method for producing seismic energy in an earth formation, comprising:
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- 3 (a) providing a cavity in a wellbore, the cavity containing a fluid;
4 (b) injecting pressure pulses into the cavity with a drive source such
5 that the cavity produces seismic waves in an adjacent earth formation; and
6 (c) circulating the fluid between the cavity and the drive source in a
7 closed loop fashion.

1 23. The wellbore system of claim 22 wherein the fluid is injected in a manner
2 that causes the cavity to resonate.

1 24. The method of claim 23 wherein the drive source includes at least one of
2 (i) a rotary valve, (ii) an electro-solenoid oscillator, and (iii) a pump.

1 25. The method of claim 22 wherein the fluid comprises a smart fluid.

1 26. The method of claim 25 further comprising providing an excitation field for
2 the smart fluid in the cavity using at least one coil.

1 27. The method of claim 26 further comprising controlling an effective length
2 of the smart fluid in the cavity by selectively energizing the at least one coil.

1 28. The method of claim 26 wherein the at least one coil includes a plurality of
2 segments, each of which can be separately energized.

1 29. The method of claim 25 further comprising controlling the injection of the
2 fluid with a control unit.

1 30. The method of claim 29 wherein the injection is controlled in response to a
2 measured parameter of interest.

1 31. The method of claim 30 wherein the measured parameter of interest is
2 selected from a group consisting of (i) pressure, (ii) temperature, (iii) seismic
3 energy, (iv) flow rate, and (v) frequency of pressure signals produced by the drive
4 source.

1 32. The method of claim 22 further comprising a controlling the injection of the
2 fluid with a control unit.